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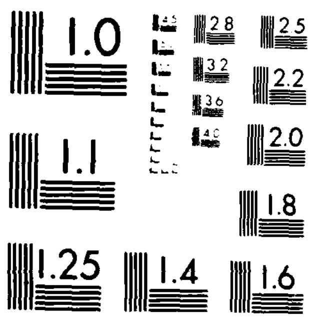

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LOCATIONAL PROBABILITIES FOR ARCHEOLOGICAL SITES
IN THE EASTERN RAPIDES - SOUTH CENTRAL
AVOYELLES REGION, CENTRAL LOUISIANA

June 1981

Final Report

Prepared for
Department of the Army
New Orleans District, Corps of Engineers
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The aim of this study was to produce reliable site density estimators and assess site locational probabilities for various watershed channels in the Eastern Rapides-South Central Avoyelles parishes area. Soil types were selected as the primary units of comparison. Based on site-soil associations in 47 previously surveyed corridors in the study area, estimates of expected site densities were determined for 33 soil types. Statistical characteristics including upper and lower bounds of a 95 percent confidence parameter of a Poisson distribution and maximum variances were also calculated for each expected density. Watershed channels, designated by the Soil Conservation Service, used or to be used to aid in flood protection and watershed management within the Corps of Engineer's project area were evaluated as to the likelihood of encountering archeological sites along their reaches. By quantifying soil units and applying the estimates of expected site density, every watershed channel was assigned a probability, expressed as a percentage, of encountering no archeological sites. To express the relationships of sample size, standard errors for the estimates were also used.

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ii

SUMMARY

The aim of this study was to produce reliable site density estimators and assess site locational probabilities for various Soil Conservation Service channels in the Eastern Rapides-South Central Avoyelles parishes area.

Soil types were selected as the primary units of comparison. Based on site-soil associations in 47 previously surveyed corridors in the study area, estimates of expected site densities were determined for 33 soil types. Statistical characteristics including upper and lower bounds of a 95 percent confidence parameter of a Poisson distribution and maximum variances were also calculated for each expected density.

Soil Conservation channels used or to be used to aid in flood protection and watershed protection within the Corps of Engineer's project area were evaluated as to the likelihood of encountering archeological sites along their reaches. By quantifying soil units and applying the estimate of the expected site density, every watershed channel was assigned a probability, expressed as a percentage, of encountering no archeological sites. To express the relationships of sample size, standard errors for the estimates were also used.

PREFACE

This study was performed under Purchase Order DACW29-81-M-1470 awarded by the U.S. Army Corps of Engineers, New Orleans District. The order was issued on 14 April 1981, and work was completed over the ensuing month and a half.

Research and report preparation were done by the author, and he alone is responsible for the report and any errors it may bear. However, several people aided in the project. The project itself was conceived by Thomas M. Ryan, Chief of the Cultural Resources Section, USACOE, who has long appreciated the need for sound projective information on cultural resources locations. Although not directly tied to previous projects sponsored by the Corps, the present study is part of an overall cultural resources management plan for South Central Louisiana developed by Ryan. The author has benefitted considerably from discussions on regional cultural resources had with Ryan over the past four years.

Personnel from the U.S. Soil Conservation Service have been of enormous help. T. D. Prestridge, Jr., Staff Leader, Watershed Planning, and Kent Milton, Soil Conservationist, of the Alexandria area office, provided essential resource materials. Prestridge made available prepublication soil distribution sheets from the Avoyelles Parish soil survey, as well as watershed project maps showing natural and already modified channels to be affected by proposed watershed improvements. His rapid responses to calls for help are primarily responsible for the timely completion of this study. Kenneth Murphy,

Soil Scientist with the SCS District Office in Opelousas, Louisiana, prepared the soil base maps for St. Landry Parish. He also provided several site locations, and his appreciation of archeological site-soil relationships has been quite instructive.

James Fogleman, Assistant Principal, Morrow Elementary School, and resident expert on St. Landry Parish archeology, provided site location data on 31 of the 47 survey corridors used as estimators. Singlely and with groups of students, Fogleman has been conducting systematic surveys in the locality over the past several years. Without his input, this project would not have been feasible.

Thanks are extended to Charles Anderson, Associate Professor of Statistics at the University of Southwestern Louisiana, for his advice on statistical matters and review of numerical calculations. He is also to be commended for his patience.

Loretta Leger produced the typescript in an efficient, professional fashion and I am grateful to her, as always, for transforming my handwriting into words.

Jon L. Gibson
Lafayette, Louisiana
May 31, 1981

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LOCATIONAL PROBABILITIES FOR ARCHEOLOGICAL SITES
IN THE EASTERN RAPIDES - SOUTH CENTRAL
AVOYELLES REGION, CENTRAL LOUISIANA

by

Jon L. Gibson

Archaeology Inc.

Research Report No. 3

I

INTRODUCTION

The Project

The present study was performed in conjunction with interrelated plans by two federal agencies--the Corps of Engineers and the Soil Conservation Service--to promote flood control for a section of South Central Louisiana. The study was sponsored by the Corps of Engineers as part of their planning of the Eastern Rapides and South Central Avoyelles Parishes project. The project was authorized by the Flood Control Act of 1970 (PL91-611) (VTN Louisiana 1975). Linked directly to Corps engineering designs are construction plans developed by the Soil Conservation Service in two adjoining watersheds, the Chatlin Lake Canal and Avoyelles-St. Landry watersheds (U.S. Soil Conservation Service 1967, 1968). The SCS work plans were authorized by the Watershed Projection and Flood Prevention Act (PL83-566).

The Study Area

Together, these flood control measures will ultimately affect an area of about 336,900 acres, or 498 square miles (U.S. Soil Conservation Service 1967:3, 1968:1; T. D. Prestridge, Jr., personal communication, 1981). The area lies in Rapides, Avoyelles, and St. Landry parishes (Figures 1 - 2). The northern boundary of the study area is marked by the confluence of the Red River and Bayou Robert. The Red

River forms the northern and eastern boundary of the area to a point several miles northwest of Marksville, Louisiana, where the line turns southward and runs irregularly eastward and then southward along the West Atchafalaya Basin Protection Levee until reaching the southern end of the study area at the junction with Bayou Rouge (Figures 1 - 2). The western and southern limits of the study area correspond (north to south) to Bayou Robert, Bayou Boeuf, Bayou Clear, U. S. Highway 71 to Dry Bayou, Dry Bayou to Bayou Petite Prairie, Bayou Petite Prairie to Bayou Rouge, and Bayou Rouge to the West Atchafalaya Basin Protection Levee (Figures 1 - 2).

The major part of the area lies in the Red River alluvial cone, a low depositional fan resulting from gradient adjustments made by the present and ancestral courses of the Red River upon reaching the Mississippi alluvial valley (Fisk 1940:36-40). On the southeastern edge of the study area, remnants of Mississippi River meanderbelts serve to delimit the extent of Red River sediments. Standing above the alluvial surfaces laid down by both Red and Mississippi rivers are isolated prairies, or islands of older alluvial and eolian sediments. These elevated inliers are vestiges of Pleistocene riverine and eolian events. The geological history of the study area has been accorded considerable attention (cf. Fisk 1940, 1944; Varvaro 1957), but the most recent work has emphasized the need for considerable reassessment (Saucier 1974; Gagliano et al. 1978; Lenzer 1981).

Generally, the study area is flat. Relief is greatest on or adjoining the islands. Elsewhere it involves only differences in elevations from levee crests to flanking backswamps. Elevations range

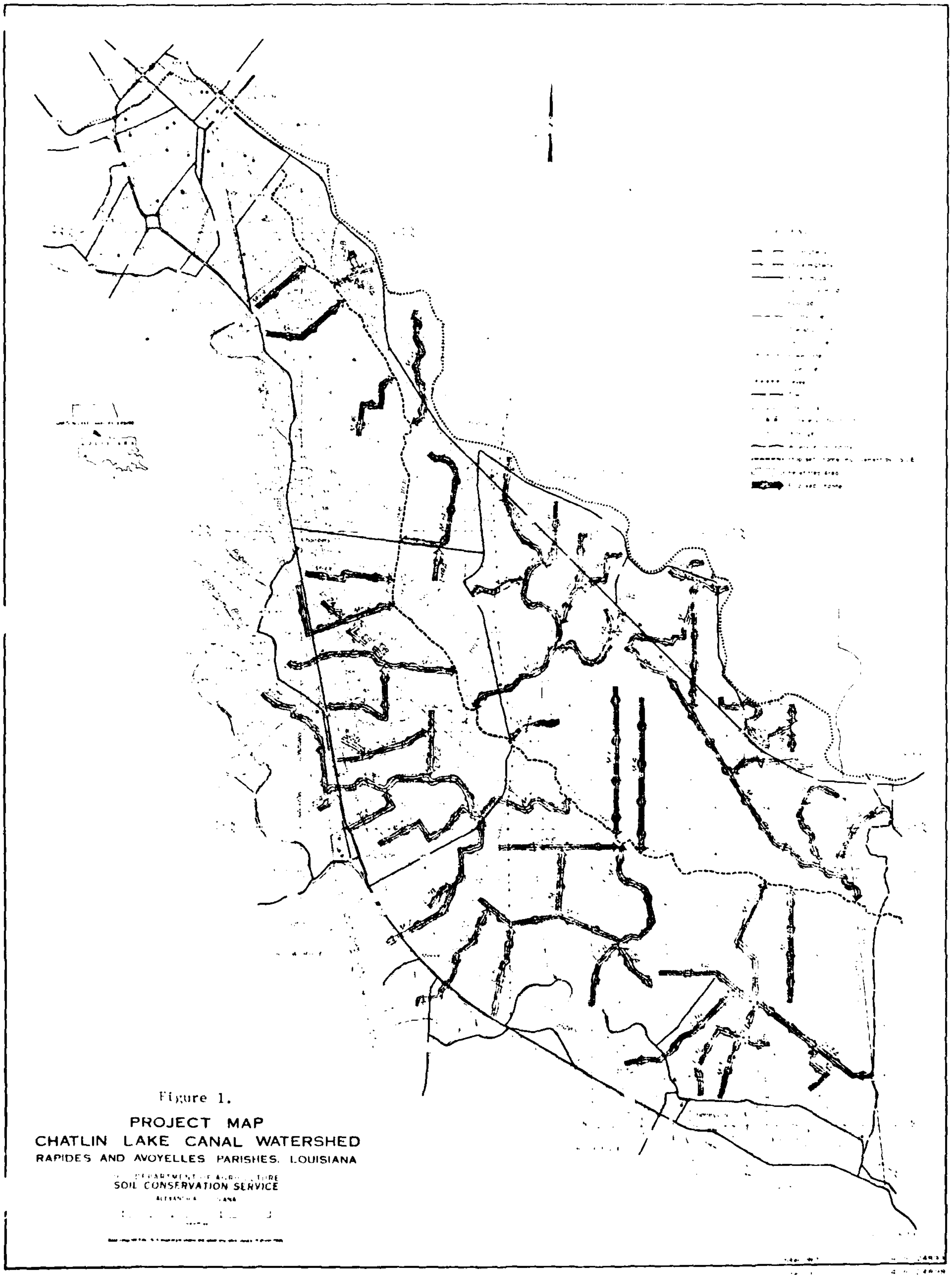

Figure 1.

PROJECT MAP
CHATLIN LAKE CANAL WATERSHED
RAPIDES AND AVOYELLES PARISHES, LOUISIANA

DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

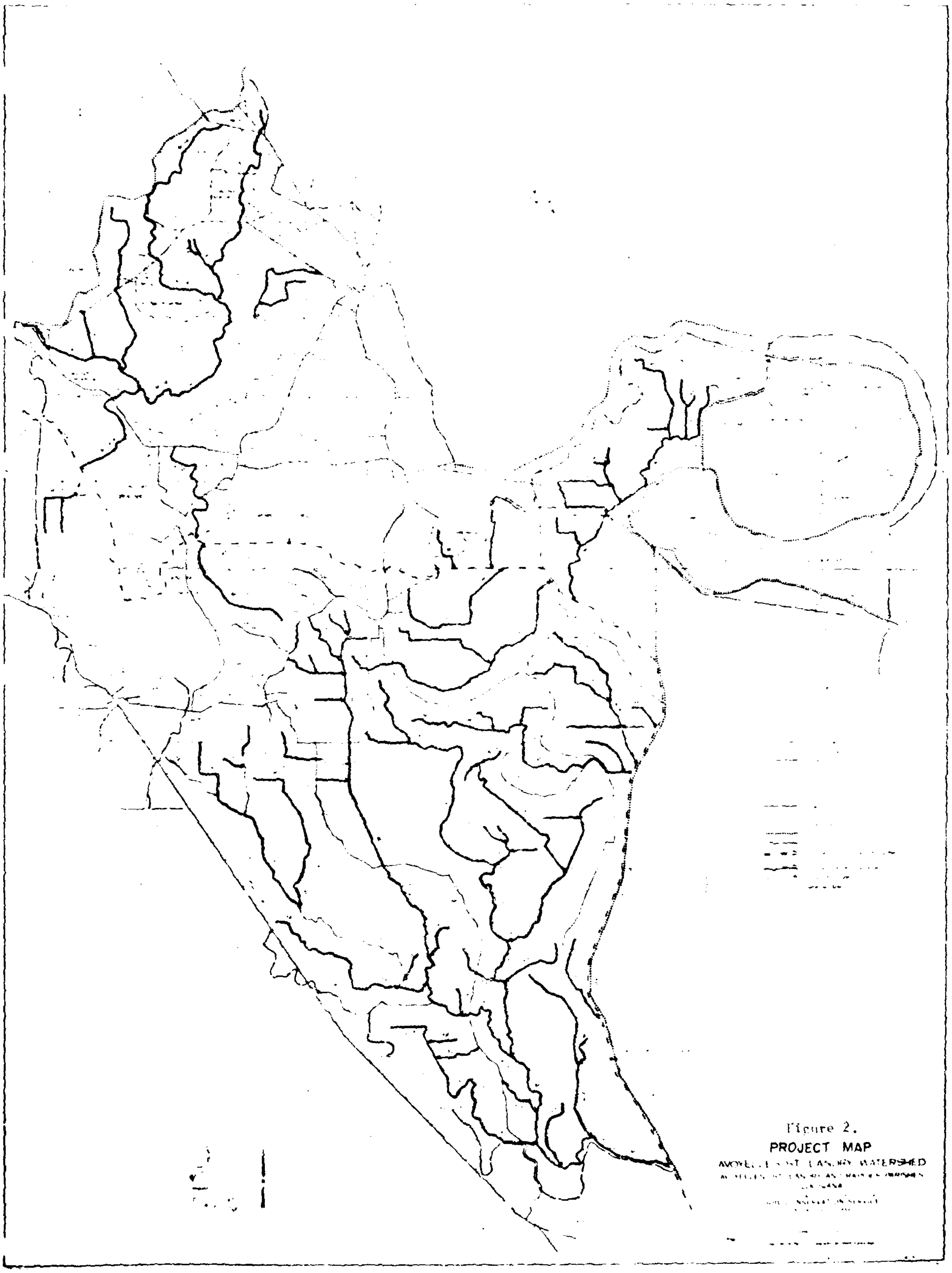

Figure 2.

PROJECT MAP

from 40 to 80 feet above sea level. Slopes are normally everywhere less than two percent, except along terrace escarpments where slopes of 25 percent or more may be encountered.

Temperate deciduous forests dominated the region prior to the recent denudation resulting from large scale soybean farming (cf. Stoddard 1812; Darby 1816). Dominant woody species included oaks, sweetgum, pecans, and ash (U. S. Soil Conservation Service 1968:4; VTN Louisiana 1975). Cane covered broad expanses of terrain (Darby 1816:105).

The Investigative Problem

In accordance with federal commitments to the protection and conservation of cultural resources, it was determined that a study which would provide projections of cultural resource locations was essential to further planning. The investigative problem centered on the distribution of cultural resources, particularly archeological sites. The objective was to determine the probability of encountering sites along various Soil Conservation channels in both watersheds. To accomplish this aim, it was necessary to establish a reliable and objective basis for projecting site location, as well as number of sites.

Thus, this study does three things: a) It produces site estimators; b) It determines the probability of any particular channel encountering an archeological site; and c) It furnishes a simple means by which future data can be plugged into the system to expand, test, and refine its projective capacities.

II

DERIVING THE ESTIMATORS

Soils

Because actual survey was limited to less than four percent of the watershed channels, it was apparent that some means of projecting from known to unknown channels and sections of the study area would have to be derived. Furthermore, the basis for projections would have to be simple, easy to understand, and capable of expansion and refinement as new information accumulated.

Soils provided an excellent means of estimating site probabilities in unknown parts of the study area. Soils are everywhere. Every site falls on a soil. Soils have been classified and named. In the area under consideration, soil distributions have been mapped by SCS personnel, and these data are available, though, with the exception of Rapides Parish (cf. Kerr et al. 1980), only in prepublication form. One does not need to be a soil scientist to know what soil is underfoot. He only needs to be able to "read" an aerial photograph. Soils are the language of soil scientists and are well understood by engineers. The use of soils as the medium of assessing site probability was likely to be more readily understandable than some other unit of comparison and was not as prone to be embrued with jargon as, say, a strictly archeological means of comparison might have been.

Though soils are appropriate and useful for present purposes, there is nothing assumed to be inherent in soil types that presages either *site location* or *site density*. In other words, there is no assumed intrinsic relationship between sites and soils. Soils do not determine site location or density. It is doubtful that soils were ever consciously (or for that matter unconsciously) considered as a single or major criterion for selecting residential or occupational locales. There is no question whatsoever that presently defined types of soil (e.g., Norwood silt loam, Norwood silty clay loam, etc.) never figured in settlement founding decisions of premodern peoples. It is unknown whether soils were ever emically categorized by Indians or early nonaboriginal settlers and if so if such categories would have approximated those of today's soil scientists. To say this another way, even if premodern folks in the study area had classified soils in their own familiar vernacular, it cannot be ascertained whether such categories, or types, would have been the same or even similar to those recognized today by pedologists.

These denials should not be a cause for concern about why soils were chosen for this demonstration. On the contrary, every site can be characterized in terms of the soil in or on which it is located. It matters not whether or not there is any real relationship, say cause-effect, between soils and site locations. Soils are common denominators of archeological sites. Because uniform data on soil distributions are available throughout the study area, soils were chosen as the most appropriate means of evaluating site probability in any given area.

Data Collection

Two kinds of data have been integrated in this study--soil distributions and site distributions.

Soil Data.

Phase I.

The study area covers parts of three parishes: Rapides, Avoyelles, and St. Landry. Only Rapides Parish was covered by a published soil survey at the time of this writing (cf. Kerr et al. 1980). Avoyelles Parish had been surveyed, and T. D. Prestridge, Jr., Staff Leader, Watershed Planning, U. S. Soil Conservation Service, kindly made pre-publication copies of aerial photo mosaics showing soil boundaries available to this author. St. Landry Parish was being surveyed by SCS personnel, and soil data from that area was personally transferred to project area maps by Kenneth Murphy, Soil Scientist.

Once soil distributional information was amassed, it was painstakenly transferred to large size project maps. Colored felt tip pens and pencils were used. The entire Chatlin Lake Watershed was colored. However, the cartographic technique used to insure relative accuracy--equal area projections--proved so time consuming that the Avoyelles-St. Landry Watershed map (covering over twice as much area as the Chatlin Lake Watershed) was not totally colored. Instead only watershed channels were colored, since these corridors were the only sections of the watershed to be evaluated for the probability of encountering archeological sites anyway.

From the colored project maps, each channel was measured to determine the extent of each soil type crossed by it. A flexible, metric ruler was used for this purpose. Measurements were made in millimeters, and compensation was allowed for the difference in scale between project maps of the two watersheds (i.e., 15 minute vis-a-vis 7.5 minute quadrangles). All soil measurement units were maintained as millimeters for both analytical and presentation purposes. The conversion factor for on-the-ground linear feet was approximately 205.

Measurements were recorded on a single tabular work sheet, which has not been reproduced here because of its large size.

Phase II.

From the colored project maps, all survey corridors used to generate estimates were measured and soil extent units were recorded on a separate large work sheet. For the St. Landry section of the Avoyelles-St. Landry Watershed, soil information for the corridors was supplied directly by Kenneth Murphy.

These previously searched corridors provided the control necessary to produce estimates of site density.

Site Data.

Phase I.

In order to gain a preliminary appreciation of site-soil associations, a total of 188 archeological sites in or on the edges of the watersheds were evaluated. The breakdown of these sites is presented in Table 1. This total includes those sites from the estimator corridors also. All available sources of information were used to

Table 1. Known Site Distribution, All Sources

Watershed	NEW RED																	
	Levee			T	R & S		T	Intermediate				T	Swamp			T	NR T
	Nd	Nw	RnB		Ro	Rr		La	Lc	MnB	MdA		MnA	MoA	MrA		
CLW	1		2	3	1		1										4
ASL	3	1		4					½ 1			½ 1		3		3	½ 8
TOT	4	1	2	7	1		1		½ 1			½ 1		3		3	½ 12

	OLD RED				OR TOT	MISSISSIPPI														MIS TOT
	Levee		T	R&S		Levee			T	Inter	R & S			T	Swamp			T	
	Ga	Gn		Pe		Dd	13	Ba		6	De	25	59		FA	Sc	SS		
CLW																			
ASL	45	2	47		47	10	9	5	24		27		*a 3	30		½ 1	1	½ 2	½ 56
TOT	45	2	47		47	10	9	5	24		27		*a 3	30		½ 1	1	½ 2	½ 56

Watershed	TERRACE LÖESS						TL TOT	HILLS					H TOT	GRAND TOTAL
	Summit		T	Lows		T								
	Me	Cu		Ca	Sl			GrC	GrD	RnB	36	0		
CLW								4	6	1		2	13	17
ASL	*b 25	1/2 1/3 2	1/2 1/3 27	1/2 1/3		1/2 1/3	2/3 28	10		2	1/3 19		1/3 31	171
TOT	25	1/2 1/3 2	1/2 1/3 27	1/2 1/3		1/2 1/3	2/3 28	14	6	3	1/3 19	2	1/3 44	188

*a, includes 2 on 57

*b, includes 1 on Md

ascertain this site sample, i.e., published and unpublished reports, state and university files and maps, and local informants. This sample cannot be used quantitatively because it was not uniformly assembled under controlled survey conditions. It was useful only in the sense of giving early expectations about site-soil associations.

Phase II.

Controlled site data were drawn from 47 separate, previously surveyed segments. The major criterion for selecting these particular segments was the fact that all had been searched thoroughly by pedestrian archeologists. Other corridors in the watersheds have been surveyed but not completely on foot. It is presumed that these compatible search procedures produced more or less comparable data.

Ten survey segments were drawn from in or near the Chatlin Lake Watershed. All of these involve revetment or realinement corridors on the Red River. They include Roberts (Gibson 1978a), Maria (Gibson 1977a), Beaver (Gibson 1977a), Hudson (Gibson 1977b, 1977c), Grand Bend (Gibson 1978b), Wiggins (Gibson 1977d), Whittington (Gibson 1977e), Hog Lake (Gibson 1977e), Wilson's Point (Gibson 1978c), and Gin Lake (Gibson 1978c).

A total of 1204 soil units of various types were encountered along these segments, as were 13 archeological sites.

The remaining 37 survey corridors lay in or near the Avoyelles-St. Landry Watershed, the majority of them in St. Landry Parish. As with the survey segments in the first watershed, all of these were covered on foot, rendering coverage of similar intensity. Five of the

included corridors represent previous cultural resources surveys: Bayou des Glaises Cutoff (Gibson 1975), State Canal Siphon (Gibson 1977f), Conveyance Structure (Gibson 1977f), Courtableau Structure (Gibson 1977f), and Teche-Vermilion Conveyance Channel (Gagliano et al. 1978). However, the lion's share of the survey corridors in this watershed were covered by James Fogleman of Morrow, Louisiana. These include: M-1 (24-27), M-1 (1-BR), M-1 (1), L-3 (361-19), L-3 (19-30), L-3 (13-24), L-3A, L-6, L-7B, L-8, DB (R4), DB (R4-3), DB (R3-2), DB (L-M), DB (L4-3), PP (29), PP (30-3), PP (24), PP (14), PP (15), PP (3-10), Wauksha (12), GR (1-SBC), GR (SBC-13), GR (BCC-12/13), GR (H-19), GR (30), BJ (33), BJ (R3), BJ (L3), and BJ (27-10). Ten segments were surveyed by Fogleman specifically for this project. The only other corridor used here lay along Big Darbonne Bayou and was intensively covered by the author and a four-man survey team in connection with a nearby project (cf. Gibson 1981).

A total of 1842 soil units were included along the surveyed alinements. The number of sites found was 69.

Combining the soil and site totals from both watershed regions produces 3046 soil units and 82 archeological sites. These totals and the revealed site-soil associations form the bases for density estimates and probability figures.

Only a small percentage (3.6 percent) of the total channel length was actually represented in the survey sample. However, the total number of soil units (3046) included in the survey sample equals 23 percent of the 13,215 soil units traversed by all channels. Even though seven soil types of the 35 types actually located along

watershed channels were not represented in the survey sample, the sample would seem to be sufficiently large to produce, in this investigator's opinion, confidence in the site density estimates extracted from it. The seven unrepresented soils pose no particular problem to estimation that cannot be justifiably overcome.

Data Organization

Soil Types

Soil types defined by the U. S. Soil Conservation Service furnished the primary units of record. Soil types will not be defined here. Their characteristics are available elsewhere (Kerr et al. 1980; unpublished information, Avoyelles Parish Soil Survey; personal communication, Kenneth Murphy). Further grouping of soil types was by landform and by parentage.

Major landform categories included natural levees, swamps, ridge and swale (or accretion belt) areas, and intermediate areas. Intermediate refers to those land surfaces between natural levees and swamps, exclusive of accretion belt terrain. The only other two landforms recognized were summits and depressions (lows); relative terms for differing areas of relief atop elevated surfaces.

Soil type-landform categories were further assembled into larger groupings based on sediment parentage, or origin. These were: a) New Red River, b) Old Red River, c) Mississippi River, d) Terrace Loess, and e) Hills. The class names should be self-explanatory. New Red River soils developed in sediments laid down by the Red River while occupying its last several meanderbelts. Old Red River soils formed

in earlier sediments. The terms Old and New, used in this context, are relative. Mississippi River sediments were deposited by an ancestral course or courses of the Mississippi River, including a major system termed the Teche-Mississippi meanderbelt (cf. Fisk 1944). Loess, or wind-blown silt, forms isolated terraces, elevated above the general level of Red and Mississippi river alluvial plains. Finally Hills soils formed in Early Pleistocene or Tertiary age sediments and are found only on the peripheries of the present study area.

Although the general historical succession of sediment origin classes reflects major geomorphic events set out in the order (youngest to oldest) presented above, chronological implications will not be developed herein. Two primary reasons are responsible for this decision. First, even though relative succession is not in doubt, there is no widely accepted chronology of discrete events which comprised these major geomorphological episodes (cf. Fisk 1940, 1944; Varvaro 1957; Saucier 1974; Gagliano et al. 1978; Lenzer 1978, 1981). Second, the purpose of the current study is to derive site estimators and afix probabilities of site occurrence to certain channel corridors. For these practical aims, explanation of site location *per se* is not relevant. The site density estimates and channel evaluations are simply heuristic means of deciding the likelihood of encountering archeological sites and thereby establishing a planning basis for agency management and design studies.

Certainly if explanation of site occurrences, particularly in terms of soil associations, were desired, it would be necessary to

produce a more exacting relative chronology firmly anchored in radiometric absolutism. This fine chronology should make possible the reconstruction of landscapes during the life of various episodes and therefore enable modeling of settlement patterns based on then existent technology and ecosystems. We are a long wav ᶠrom reaching this desirable state of knowledge in south central Louisiana. However, this simply means that we lack one useful avenue for explaining site location. It does not mean that unknown localities cannot be evaluated in terms of the probabilistic occurrence of archeological sites. Determining where sites are is not the same as telling why they are there.

Sites

No effort was made to classify or otherwise group sites according to historical, functional, or other criteria. Even the word site itself covers a range of situations. At one end of the scale are large mound complexes like Marksville, Greenhouse, and Stelley. At the other are tiny spots which produced a handful of artifacts. Some sites are recognized by standing, above-the-ground structures, or facilities, or by visible remains of them. Except for the isolated examples of earth architecture ("Indian mounds") in the sample, most of the sites of this kind are historic, or modern, Euro- or Afro-American house places. The overwhelming majority of sites, however, are products of Native Americans and are prehistoric. All sites in the sample, regardless of age and the racial or ethnic origins of their occupants, have archeological dimensions and can be analyzed from that viewpoint.

Procedural Matters

The purpose of this study is to determine the likelihood of encountering cultural resources along any given channel in two watersheds in south central Louisiana. To accomplish that objective, it is necessary to generalize from a limited set of available information to a much larger corpus of data that covers a much greater geographic territory. One way to make such generalizations is through statistics. When going from a small known data array to a larger unknown field, it is essential to set forth the characteristics and limitations of the "sample" and employed manipulative processes.

Because the entire area under study has not been surveyed, it is necessary to make certain assumptions about data distributions that will permit sample description and allow estimates (probabilities) to be made about unknown sections of the study area. It is assumed here that the Poisson frequency distribution (cf. Gregory 1963:68-72) will approximate the distribution of archeological sites. Unlike other sorts of statistical distributions, the Poisson distribution is amenable to comparison with data arrays comprised of whole numbers specifying the number of times that certain conditions (i.e., the presence of archeological sites) obtained, and for which it is not possible or nonsensical to specify the number of times that the conditions do not exist (i.e., the number of times that sites do not occur). Archeological sites can be counted. The number of times that archeological sites do not occur at a given location or on a specific soil type cannot be counted. Coupled with the expected

zero values and the likelihood of extreme differences between values in the array, the Poisson frequency distribution has thus been adopted as an approximation for the distribution of archeological sites.

In order to come up with sound estimates and probabilities of site occurrences in the study area, certain statistical parameters of the sample data were required. From the sample of 47 surveyed tracts, site densities were calculated for each soil type (Table 2). These figures provided estimates of the expected number of sites along the various watershed channels based on sample soil means. Other essential statistics included upper and lower bound confidence limits (based on 95 percent probability), variances, and standard errors of the estimates (Tables 2-3).

Site density estimates were calculated by dividing the summed soil units (N) of each type from all surveyed corridors by the total number of sites (X) found on each soil type. The resulting density estimates ($\hat{\lambda}$) are given in Table 2, along with summary data on soil units and sites. The site density estimates are shown per 1000 soil units in order to preserve the significant digits in the calculated estimators.

Also presented in Table 2 are the upper and lower bounds for a 95 percent confidence interval and the estimator variances based on the values of the upper bound limit. The upper and lower bounds establish the limits of the 95 percent confidence parameter for each site density estimate. The 95 percent confidence interval was set arbitrarily so that the range of deviation around the estimate of

expected site density ($\hat{\lambda}$) could be assessed. It is essential to establish some limits of confidence because the calculated site density figures are simply best estimates based on sample data, not true values of the population under consideration.

Upper and lower bounds for each value of $\hat{\lambda}$ were determined with reference to a standard table of confidence limits of a Poisson parameter (cf. Odeh et al. 1977:Table 23). The lower range of confidence was set at 0 when the estimate of the expected site density ($\hat{\lambda}$) was 0. When the estimate was 1.0 or more, the lower limit was calculated by dividing the total number of sites on each soil type into the table values found by reading down the .025 column on $\underline{\rho}$ (probability) axis to the row ($\underline{c}$) corresponding to the total number of sites on each soil. The upper bound was found similarly by using the confidence limit values in the 0.975 $\underline{\rho}$ column. The limits of 95 percent confidence for each estimate of expected density on each soil type are given in Table 2.

From the upper bound values, maximum variances (S^2) of the estimates were determined. Upper bound confidence limits were used in the calculations in order to make the maximum possible allowance for variation from the estimated site densities. Maximum estimator variances were figured by the formula: $S^2 = 1000\hat{\lambda}/N$. The factor of 1000 was inserted into the formula to bring out the significant digits.

Table 2 summarizes the estimates of the expected soil densities according to soil type based on sample data. Also included are the

KEY TO ABBREVIATIONS

Nd	Norwood silt loam
Nw	Norwood silty clay loam
RnB	Roxana very fine sandy loam, gently undulating
NRLTOT	Total, New Red Levee soils
Ro	Roxana very fine sandy loam, occasionally flooded
Rr	Roxana soils, frequently flooded
NRRSTOT	Total, New Red Ridge and Swale Soils
La	Latanier silty clay loam
Lc	Latanier clay
MnB	Moreland clay, gently undulating
MdA	Moreland silty clay loam, 0-1% slopes
NRITOT	Total, New Red Intermediate Soils
MnA	Moreland clay, 0-1% slopes
MoA	Moreland clay, 0-1% slopes, occasionally flooded
MrA	Moreland clay, 0-1% slopes, frequently flooded
NRSTOT	Total, New Red Swamp Soils
NRTOT	Totals, All New Red Soils
Ga	Gallion silt loam
Gn	Gallion silty clay loam
ORLTOT	Total, Old Red Levee Soils
Pe	Perry clay, frequently flooded
ORTOT	Total, All Old Red Soils
Dd	Dundee silt loam
13(Df)	Dundee silty clay loam
Ba/Bd	Baldwin silty clay loam
MLTOT	Totals, Mississippi Levee soils
6	Dundee variant clay
De	Dundee-Sharkey complex, gently undulating
57	Tensas-Sharkey complex, gently undulating
59	Tensas silty clay
MRSTOT	Totals, Mississippi Ridge and Swale Soils
FA	Fausse clay
Sc	Sharkey clay
SS	Sharkey soils, occasionally flooded
So	Sharkey clay, occasionally flooded
Sk	Sharkey clay, frequently flooded
MSTOT	Totals, Mississippi Swamp Soils
Me	Memphis silt loam, 0-3% slopes
Md	Memphis silt loam, 0-5% slopes
Cu	Coteau silt loam, 1-3% slopes
TLSTOT	Totals, Terrace Loess Summit Soils
Ca	Calhoun silt loam
S1	Solier clay
TLLTOT	Totals, Terrace Loess Lows Soils
TLTOT	Totals, all Terrace Loess Soils
GrC	Gore very fine sandy loam, 1-5% slopes
GrD	Gore very fine sandy loam, 5-12% slopes
KnB	Kolin silt loam, 1-5% slopes
36	Loring silt loam, 2-5% slopes
RsB	Ruston fine sandy loam, 1-3% slopes
RsC	Ruston fine sandy loam, 3-8% slopes
SmF	Smithdale fine sandy loam, 12-20% slopes

Table 2. Estimation of Site Density

Soil Type	No. of Soil Units (N)	No. of Sites (X)	Est. Density Per 1000 Units ($\hat{\lambda}$)	Lower Bound for λ	Upper Bound for λ	Max. Estimator Variance ($S^2 = 1000\,\hat{\lambda}/N$)
Nd	69	0	0	0	53.46	774.8
Nv	37	0	0	0	99.7	2694.7
RnB	756	4	5.29	2.15	13.55	17.9
NRLTOT	862	4	4.62	1.88	11.88	13.8
Ro	131	1	7.63	1.85	42.53	327
Rr	49	0	0	0	75.29	1536.4
NRRSTOT	180	1	5.56	1.34	30.96	172
La	-	-	-	-	-	-
Lc	10	0	0	0	368.9	36890
MnB	-	-	-	-	-	-
MdA	-	-	-	-	-	-
NRITOT	10	0	0	0	368.9	36890
MnA	23	0	0	0	160.39	6973.5
MoA	176	0	0	0	20.96	119.1
MrA	12	0	0	0	307.42	25618.1
NRSTOT	211	0	0	0	17.48	2.9
NRTOT	1263	5	3.96	1.74	9.24	7.3
Ga	492	26	52.85	36.16	77.43	157.4
Gn	53	1	18.87	.47	105.13	1983.6
ORLTOT	545	27	49.54	34.14	72.08	132.3
Pe	6	0	0	0	614.83	102.5
ORTOT	551	27	49	33.77	71.3	129.4
Dd	164	9	54.88	29.24	104.18	635.2
13	50	6	120	56.28	261.18	522.4
Ba	60	5	83.33	36.7	194.47	324.1
MLTOT	274	20	72.99	47.44	112.73	411.4
6	-	-	-	-	-	-
De	72	10	138.89	76.26	255.42	354.8
59	-	-	-	-	-	-
MRSTOT	72	10	138.89	76.26	255.42	354.8
FA	85	0	0	0	43.4	510.6
Sc	41	0	0	0	89.98	219.5
SS	88	1	11.36	.28	63.32	129.5
MSTOT	214	1	4.67	.12	26.04	121.7
MTOT	560	31	55.36	39.09	78.58	140.3
Me	430	21	48.84	32.06	74.65	173.6
Cu	24	0	0	0	153.71	640.5
TLSTOT	454	21	46.26	30.37	70.71	155.7
Ca	42	0	0	0	87.83	209.1
S1	-	-	-	-	-	-
TLLTOT	42	0	0	0	87.83	209.1
TLTOT	496	21	42.34	27.8	64.72	130.5
GrC	96	4	41.67	16.91	106.69	110.4
GrD	48	4	83.33	33.81	213.38	444.5
KnB	3	0	0	0	1229.67	409.9
36	-	-	-	-	-	-
0	29	0	0	0	127.21	438.7
HTOT	176	8	45.45	23.38	89.36	508.9
GRAN TOT	3046	82				

soil units and sites used to calculate the estimates, as well as certain sample parameters pertaining to confidence intervals. These estimates are the bases for the projections shown in Table 3.

III

SITE PROBABILITY

Introduction

This section sets forth the probabilities of archeological site occurrence along channels in the project area based on the estimates derived in the preceding section. Probabilities are given for each channel shown on the project maps and are specified (named) by the same designations, e.g., M-1, M-2, M-3, etc. (Table 3). Since the estimates of expected site densities are expressly provided by individual soil type, and since the channels often run across more than one soil type, further calculations and specification of statistical parameters are required in order to determine the probability of site occurrence on each channel. These additional operations are discussed below.

Determining Probability

Large work sheets were prepared which showed the number of soil units of various types along each channel, main and lateral. Estimates of the expected site densities ($\hat{\lambda}$) and maximum estimator variances (S^2) were also transferred to these work sheets to make for ease of reference for the necessary calculations. Units of each type of soil along every channel were totaled. In another column, expected site densities were calculated for each soil type along the channel via

the formula: $\frac{N}{1000}\hat{\lambda}$. The resulting values were summed, providing an overall estimate (μ) of the expected number of sites along that particular channel, expressed in terms of sites per 1000 soil units. These estimates are given in Table 3.

In addition, the large work sheets bore other vital numbers, such as the values of

$$\left(\frac{N}{1000}\right)^2 s^2 \quad \text{and} \quad \sum\left(\frac{N}{1000}\right)^2 s^2 ,$$

essential steps in calculating standard errors of the estimates (SE). Only the values of

$$\sum\left(\frac{N}{1000}\right)^2 s^2$$

are reproduced in Table 3, so that the standard errors may be quickly replicated, or checked.

Standard errors of the estimate of expected sites along each channel are represented in Table 3. They were determined by the formula:

$$\sqrt{\sum\left(\frac{N}{1000}\right)^2 s2} \; .$$

It should be recalled that standard errors were based on 95 percent confidence limits on a Poisson distribution and are essential to assessing the potential limits of estimator error due to sample size. The probability column of Table 3 should be read with the standard error of the estimate in mind.

By these devices, we have arrived at the central focus of this investigation, the establishment of channel-specific site probabilities (Table 3). Actually once the estimates of expected site densities were determined for each soil type, afixing a statistical probability to encountering archeological sites along each channel was a relatively

Table 3. Probability of No Sites Along Watershed Channels

Channel	$\sum \frac{N}{1000} \hat{\lambda}$ $\hat{\mu}$	$\left(\frac{N}{1000}\right)^2 s^2$	Standard Error $\sqrt{\sum\left(\frac{N}{1000}\right)^2 s^2}$	Probability of No Sites %
(Chatlin Lake):				
M1	.0159	625.3	25	98.4
L-1A	0	2.6	1.61	100.0
L-1B	.0688	21.4	4.63	93.4
L-1C	0	4	2	100.0
L-1C1	0	43	6.56	100.0
L-1C2	0	.1	.32	100.0
L-1D	0	5.8	2.41	100.0
L-1F	0	1.1	1.05	100.0
M-2	0	320.1	17.89	100.0
M-3	0	344.1	18.55	100.0
L-3A	0	42.8	6.54	100.0
L-3A1	0	27.5	5.24	100.0
L-3B	0	27.8	5.27	100.0
L-3B1	0	16.4	4.05	100.0
L-3C	0	8.3	2.88	100.0
L-3D	0	13.6	3.69	100.0
M-4	0	6.6	2.57	100.0
M-5	0	921.1	30.35	100.0
L-5A	0	13.3	3.65	100.0
L-5B	0	3.5	1.87	100.0
L-5C	0	18.9	4.35	100.0
L-5D	0	81.1	9.01	100.0
L-5E	0	8.5	2.92	100.0
M-7	1.4268	185.7	13.63	24.0
L-7B	0	1.1	1.05	100.0
L-7C	0	130.4	11.42	100.0
L-7C1	0	115.7	10.76	100.0
L-7C2	0	26.9	5.19	100.0
L-7C2A	0	143.5	11.98	100.0
L-7C2A1	0	42.6	6.53	100.0
L-7C3	0	39.5	6.28	100.0
L-7C4	0	2	1.41	100.0
M-8	0	27.4	5.23	100.0

Table 3 Continued

Channel	$\Sigma \frac{N}{1000} \hat{\lambda}$ $\hat{\mu}$	$\left(\frac{N}{1000}\right)^2 s^2$	Standard Error $\sqrt{\Sigma\left(\frac{N}{1000}\right)^2 s^2}$	Probability of No Sites %
M-9	3.4382	98.6	9.93	3.2
L-9A	0	310.2	17.61	100.0
L-9A1	0	2.6	1.61	100.0
L-9B	0	23	4.8	100.0
L-9B1	0	7.1	2.66	100.0
L-9C	0	2.8	1.67	100.0
L-9D	1.3872	8.3	2.88	25
M-10	0	12.5	3.54	100.0
L-10A	0	7.1	2.66	100.0
M-12	0	68.4	8.27	100.0
L-12A	0	14.3	3.78	100.0
L-12B	0	7.3	2.7	100.0
M-13	0	24.4	4.94	100.0
M-14	0	102.3	10.11	100.0
L-14A	0	9	3	100.0
M-15	.2116	108.7	10.43	80.9
M-16	0	20.7	4.55	100.0
M-17	0	10.4	3.22	100.0
M-18	.0053	2.8	1.67	99.5
L-18A	0	.2	.45	100.0
L-18B	0	.6	.77	100.0
M-19	0	6.5	2.55	100.0
(Avoyelles-St. Landry):				
M-1	23.2073	326.7	18.07	0
L-3	6.2802	141.6	11.9	.2
L-3A	0	9.1	3.02	100.0
L-3B	0	3.7	1.92	100.0
L-5*	7.2351	282.5	16.81	.1

Table 3 Continued

Channel	$\Sigma \frac{N}{1000} \hat{\lambda}$ $\hat{\mu}$	$\left(\frac{N}{1000}\right)^2 s^2$	Standard Error $\sqrt{\Sigma\left(\frac{N}{1000}\right)^2 s^2}$	Probability of No Sites %
L-5A *	1.1818	7.8	2.79	30.7
L-5C	4.2801	6.2	2.49	1.4
L-5C1	1.8056	12.4	3.52	16.4
L-5C1A	.36	1.3	1.14	69.8
L-5C1B	2.1897	.7	.84	11.2
L-5C2	2.8598	1.2	1.1	5.7
L-5D	1.516	.2	.45	22
L-5D1	.3699	.3	.55	69.1
L-5D2 *	.1057	.5	.71	90
L-5E *	.2048	.1	.32	81.5
L-6	0	9.8	3.13	100.0
L-7 *	0	365.6	19.12	100.0
L-7A	.6143	606.8	24.63	54.1
L-7B	0	.3	.55	100.0
L-7C	0	2.1	1.45	100.0
L-7D	0	4.2	2.05	100.0
L-7D1	0	2.4	1.55	100.0
L-7E	0	.3	.55	100.0
L-8	0	.9	.95	100.0
L-9	0	.2	.45	100.0
L-10	0	18.7	4.32	100.0
L-11	0	.1	.32	100.0
L-12	0	2.8	1.67	100.0
L-12A	0	1.9	1.38	100.0
L-13	0	7.3	2.7	100.0
L-14	0	6.2	2.49	100.0
L-15	0	3.8	1.95	100.0
M-3	11.3333	24.1	4.91	0
L-1	0	3.3	1.82	100.0
L-2 *	2.9167	1.6	1.26	5.4
L-3 *	2.5	1.1	1.05	8.2
M-4	.938	19.3	4.39	39.1
L-1	0	4.6	2.14	100.0
L-2	0	3.9	1.97	100.0
L-3	1.582	1.1	1.05	20.6
M-5	.2972	10.8	3.29	74.3

Table 3 Continued

Channel	$\sum \frac{N}{1000} \hat{\lambda}$ $\hat{\mu}$	$\left(\frac{N}{1000}\right)^2 s^2$	Standard Error $\sqrt{\sum\left(\frac{N}{1000}\right)^2 s^2}$	Probability of No Sites %
M-6	0	87.2	9.34	100.0
L-1	0	.9	.95	100.0
M-7	.6275	25.4	5.04	53.4
L-1	0	.1	.32	100.0
L-2	0	15.1	3.89	100.0
L-3	0	19.6	4.43	100.0
L-3A	0	4.	2.	100.0
L-3B	0	0	0	100.0
L-4	.5366	2.3	1.52	58.5
L-4A	0	1.1	1.05	100.0
L-4A1	0	12.4	3.52	100.0
L-5	0	1.3	1.14	100.0
M-8	0	8.6	2.93	100.0
M-9	0	1.5	1.22	100.0
M-10	0	.3	.55	100.0
M-12	0	20.1	4.48	100.0
M-13	0	.2	.45	100.0
L-1	0	.1	.32	100.0
M-14	.0106	64.9	8.06	99
L-1	0	2.4	1.55	100.0
L-1A	0	.8	.89	100.0
L-1A1	0	.2	.45	100.0
L-2	0	1.7	1.3	100.0
L-2A	0	23.3	4.83	100.0
L-3	0	27.1	5.21	100.0
L-3A	.1111	7.2	2.68	89.5
L-3A1	0	6.2	2.49	100.0

* These channels were deleted from the Avoyelles-St. Landry watershed as a result of plan modifications by the Soil Conservation Service during preparation of this report.

simple matter. In actuality, it is not the probability of any given channel intersecting an archeological site that is being specified, but rather the null corrollary--the likelihood that a particular channel will not intersect an archeological site. Individual probability figures, expressed as percentages, were calculated by taking the negative inverse natural logarithm of $\hat{\mu}$ (estimate of expected site density) for each channel. These procedures were considerably facilitated by using a TI Programmable 58C pocket calculator.

Thus the last column of Table 3 provides, within 95 percent confidence limits, the probability of any given channel encountering no archeological sites.

Significance

Site location, or site locational probability, is simply one side of the cultural resources management coin. Significance, or potential significance, is the other. Significance is the factor that will determine whether or not the location will merit further investigation, mitigation, and/or listing on the National Register of Historic Places. It would therefore be extremely helpful if significance probabilities could be added to locational ones, thereby providing more precise estimators for agency planning.

For significance to be decided in any manner that is meaningful and defendible, it must be done under an explicit plan, using criteria from National Register guidelines (36 CFR Part 60.6) and an evaluatory framework built of local, regional, and/or national knowledge.

Because so much of what goes into making decisions about significance is not a function of site, or place, but derives from comparison with other places, it is much harder to produce reliable estimators of significance, or to come up with statistical factors that could be used to modify locational probabilities. For example, DuPont-Des Glaises, a small, Coles Creek hamlet on a hummock in the middle of a swamp (Gibson 1981), may of itself be rather inconsequential but as a representation of a more widespread cultural manifestation, it may become quite important.

There is another difficulty with producing estimators of significance. Some sites are just simply unique and cannot be predicted. Hindsight may help to explain locations, such as Poverty Point, Troyville, or Marksville, but there can be no denying their uniqueness during the times they were thriving population centers and there can be little argument that if they were not already known their existence would not have even been suspected much less their locations predicted. How could one have predicted the location of Lloyd's Hall, built in 1816, or the Wytchwood Plantation manor, constructed before 1824? How could one have predicted association with historical persons, manifestations of architectual importance, or works of masters? Most of the National Register guidelines do not lend themselves to prediction. In other words, because they are historically or materially (architectually) orientated, sites must be discovered first and the historical and architectural background appreciated before significance can be evaluated. They are really de post facto considerations, certainly not conducive to research designs incorporating predictive measures.

As a corollary, the historical bias of Register criteria means that any given sample of sites and properties (such as the present 188 sites) divided into significant and not significant components, cannot be used to extrapolate to potential populations of cultural resources.

Certainly such factors (Register criteria) as age (over 50 years), in situ condition (integrity of location), and perhaps even type or construction representativeness might be capable of being extrapolated to undiscovered cultural resources populations, but these stipulations, in and of themselves, are insufficient, in this author's opinion, to make sound determinations of significance in all cases. Added to the impossibility of prediction based on historical and architectural considerations, the burden of significance demonstration falls primarily on the solitary Register criterion of (districts, buildings, structures, and objects. . .) ". . . that have yielded, or may be likely to yield, information important in prehistory or history." (36 CFR Part 60.6).

However, there is a "catch" to incorporating this factor into a predictive formula for the two watersheds under consideration here. The culture history of the territory covered by the Chatlin Lake and Avoyelles-St. Landry watersheds is so poorly known that we cannot decide at present what constitutes important information, a key in application to specific site data. If it cannot be said with complete confidence that a site has produced information relevant to filling in explicit gaps in cultural knowledge--gaps defined by careful scrutiny and evaluation of existing knowledge--or that a site has potential to

produce such desirable kinds of information, it will be exceedingly hard to defend decisions regarding significance.

Thus before significance can be included in predictive efforts, there must be critical appraisal of available information and production of an overall synthesis for the region in question, a synthesis which not only states what is known but what is not known. What is not known will, of course, be conditional on what we wish to know. Until the time that such a synthesis becomes available, significance evaluation will continue to occur only after a site has been discovered and only then in terms of itself or in terms of a relative context totally dependent on the skills and perceptive abilities of the person doing the evaluating. In other words, until there is a basis for doing so, potential significance cannot be predicted like locations themselves can be predicted. We cannot at present, under the view of significance criteria espoused above, determine the likelihood of encountering (or actually not encountering) significant cultural resources along various watershed channels.

Such a prospect is within grasp. At least it has been recognized not only as desirable but rather essential to efficient management of cultural resources in the southern sections of Central Louisiana.

IV

CONCLUSIONS

Cultural resource management programs require information on site locations in order to be effective. The earlier in the management process such data become available, the quicker sound, reliable planning for conservation and management can be implemented. The present study represents an effort to provide that early information for the Eastern Rapides-South Central Avoyelles region.

By utilizing available information on site locations and soil associations in 47 previously surveyed corridors in the area, estimates of expected site densities have been determined for 33 soil types. Quantitative characterization of various Soil Conservation Service channels by soil types has permitted the statistical probability of encountering no archeological sites to be determined.

The present findings must be regarded as preliminary. The derived densities are based on a sample of only slightly more than 118 linear miles and 82 archeological sites. Although preliminary, the derived estimates represent the only such figures produced for the region for the express purpose of aiding agency planning. Notions of site locations, high probability areas, and other vague, totally subjective beliefs about where archeological sites should occur are bantered around in archeological circles and reverberate through the correspondence and promulgated rules of this country's federal and

state cultural resource overseers. Yet very few areas of the country are blessed with reliable, workable means of assessing site probabilities in unsurveyed sections. Louisiana is not among them.

This study then represents an advance proposition. It has realized associations, affinities if you will, of sites and certain soil types. Based on a relatively small sample, it has quantified these associations and via statistical probabilistic means has used them to assess whether or not certain channels to be dug or improved by the Soil Conservation Service may encounter archeological sites. The likelihood of these encounters can be read directly from a table (Table 3). The derived estimators can be used to determine the chances of encountering sites along channels not yet off the drawing board or even proposed. The estimators can be refined and recalculated, giving even greater precision, when new data are realized. Yes, this study is an advance proposition, but it is an objective one and one which is capable of unlimited refinement, hence precision.

It is not hypothetical. It does not seek to explain why sites tend to associate differentially with soils. It therefore cannot be tested. It can be replicated if one should wish. But most importantly, it can be used. It can be expanded, and it can be refined. It is a preliminary study and as such will have the faults of novelty. Yet, it is a start, a long overdue one, toward pattern recognition of the sort that will aid both agency and science and that will ultimately lead to increased understanding.

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